IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: **Alawani, et al.**	Art Unit: 2841
Serial No.: 10/623,243	Examiner: Levi, Dameon E.
Filed: July, 17, 2003	
For: **Overmold MCM with Increased Surface Mount Component Reliability**	

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Honorable Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This is an Appeal from the Examiner's Final Rejection of claims 1, 3-6, 9-14, 16, 18, and 19. The Final Rejection issued on January 10, 2007. The Notice of Appeal was filed in the U.S. Patent and Trademark Office on May 9, 2007.

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02 FC:1251 120.00 OP

REAL PARTY IN INTEREST

The real party in interest is Skyworks Solutions, Inc.

RELATED APPEALS AND INTERFERENCES

There are no related Appeals or Interferences.

STATUS OF CLAIMS

Claims 1, 3-6, 9-14, 16, 18, and 19 are pending, and claims 2, 7, 8, 15, 17, and 20 were canceled in previous amendments. Claims 1, 3-6, 9-14, 16, 18, and 19 have been finally rejected in a Final Rejection dated January 10, 2007. This Appeal is directed to the rejection of claims 1, 3-6, 9-14, 16, 18, and 19 which appear in the attached "Appendix of Claims on Appeal."

STATUS OF AMENDMENTS

No claim amendments have been entered after issuance of the Final Rejection of January 10, 2007.

SUMMARY OF CLAIMED SUBJECT MATTER

A. Claim 1

Independent claim 1 defines an overmold module (e.g., structure 100 in Figure 1) including a surface mount component (e.g., surface mount component 102 in Figure 1) situated over a laminate circuit board (e.g., substrate 104 in Figure 1), where the overmold module is an MCM. *See*, e.g., page 7, lines 19-21, page 8, lines 2-3 and Figure 1 of the present application. The surface mount component can be, for example, a passive component such as a resistor, a capacitor, an inductor, a diplexer, a diode, or a surface acoustic wave filter. *See*, e.g., page 8, lines 12-14 of the present application. The surface mount component includes a first terminal (e.g., terminal 116 in Figure 1) and a second terminal (e.g., terminal 118 in Figure 1). *See*, e.g., page 8, lines 10-11 and Figure 1 of the present application. The overmold module further includes a first pad (e.g., pad 106 in Figure 1) and a second pad (e.g., pad 108 in Figure 1) situated on the laminate circuit board, the first pad being connected to the first terminal (e.g., terminal 116 in Figure 1) and the second pad being connected to the second terminal (e.g., terminal 118 in Figure 1). *See*, e.g., page 8, lines 2-3 and lines 10-11 and Figure 1 of the present application.

The overmold module (e.g., structure 100 in Figure 1) further includes a solder mask trench (e.g., solder mask trench 124 in Figure 1) situated underneath the surface mount component (e.g., surface mount component 102 in Figure 1), where the solder mask trench is situated over a top surface (e.g., top surface 110 in Figure 1) of the laminate circuit board (e.g., substrate 104 in Figure 1). *See*, e.g., page 8, lines 21-22,

page 9, line 1. The solder mask (e.g., solder mask 112 in Figure 1) uniformly covers the top surface (e.g., top surface 110 in Figure 1) of the laminate circuit board (e.g., substrate 104 in Figure 1), however the solder mask does not cover the solder mask trench (e.g., solder mask trench 124 in Figure 1). *See*, e.g., page 8, lines 5-7, page 9, lines 1-2, and Figure 1 of the present application.

A bottom surface (e.g., bottom surface 126 in Figure 1) of the surface mount component (e.g., surface mount component 102 in Figure 1) and the top surface (e.g., top surface 110 in Figure 1) of the laminate circuit board form a moldable gap (e.g., moldable gap 125 in Figure 1). *See*, e.g., page 9, lines 5-7 and Figure 1 of the present application. The moldable gap includes the solder mask trench (e.g., solder mask trench 124 in Figure 1). *See*, e.g., page 9, lines 5-7 and Figure 1 of the present application. The solder mask trench (e.g., solder mask trench 324 in Figure 3) is filled with a molding compound (e.g., undermold 326 in Figure 3). *See*, e.g., page 11, lines 18-19 and Figure 3 of the present application.

Thus, the moldable gap (e.g., moldable gap 325 in Figure 3) and the solder mask trench (e.g., solder mask trench 324 in Figure 3) facilitate a flow of the molding compound (e.g., undermold 360 in Figure 3) underneath the surface mount component (e.g., surface mount component 302), which as disclosed in the present application, reduces the risk of forming voids in the moldable gap during the molding process. *See*, e.g., page 12, lines 2-4 and Figure 3 of the present application.

B. Claim 9

Independent claim 9 defines substantially the same subject matter as independent claim 1.

C. Claim 16

Independent claim 16 defines substantially the same subject matter as independent claim 1, with a difference being that claim 16 defines a multi-terminal surface mount device (as opposed to the two-terminal surface mount device defined by claim 1). Likewise, claim 16 defines multiple pads (as opposed to the two pads defined by claim 1) on the laminate circuit board, the pads being connected to the respective terminals of the surface mount device.

GROUND(S) OF REJECTION TO BE REVIEWED ON APPEAL

A. Claims 1, 3-6, 9-14, 16, 18, and 19 under 35 USC §103(a) as being unpatentable over U.S. Patent No. 6,521,997 to Huang et al. (hereinafter "Huang") in view of U.S. Patent No. 5,502,289 to Takiar et al. (hereinafter "Takiar").

ARGUMENT

A. Rejection of claims 1, 3-6, 9-14, 16, 18, and 19 under 35 USC §103(a) as being unpatentable over Huang in view of Takiar.

Appellant respectfully submits that the present invention, as defined by independent claims 1, 9, and 16 is patentably distinguishable over Huang and Takiar, either singly or in combination.

Huang is directed to providing a chip carrier for accommodating a passive component, which can "prevent the occurrence of short circuit between the passive component and solder pads." Huang, column 2, lines 19-22. Huang specifically discloses chip carrier 1 including core layer 10, which is defined with chip attach area 100 for mounting a chip thereon and trace forming area 101 surrounding chip attach area 100. Huang, column 3, lines 5-10.

In the Final Office Action, the Examiner has stated that Huang discloses "a module comprising: a surface mount component (elements 15, 15' Figs 1-4) situated over a laminate circuit board (elements 10, 1' Figs 1-4) ...." The Final Office Action of January 10, 2007, page 2. However, Huang does not teach or disclose the use of a laminate circuit board in an MCM (multi-chip module) as disclosed and claimed by the present invention. Huang actually teaches away from the use of a laminate circuit board in an MCM by disclosing that: "chip carrier 1' [sic] of the second embodiment [shown in Figure 4 of Huang] is structurally identical to that of the first embodiment [shown in Figures 1 and 2

of Huang], as both are a substrate for use in a BGA (ball grid array) semiconductor package." Huang, column 4, lines 5-8.

Thus, Huang is directed to a discrete chip packaging technology and not to an MCM comprising a laminate circuit board, as specified in independent claims 1, 9, and 16. The chip carrier in a ball grid array package disclosed by Huang is not analogous to a laminate circuit board in an MCM. A ball grid array package is utilized prior to integrating various packages (such as a BGA package) and/or various surface mount components and devices on a laminate printed circuit board in an MCM. In other words, Huang's ball grid array semiconductor package is intended to be mounted onto and supported by a laminate printed circuit board, such as that specified in independent claims 1, 9, and 16.

Thus, Huang is directed to a discrete semiconductor packaging technology, while the present invention is directed to a laminate printed circuit board technology as utilized in an MCM, the latter being suitable for housing a discrete semiconductor package, such as Huang's semiconductor package. Huang, therefore, is directed to a different technology (i.e., to BGA semiconductor packaging) than the present invention. As such, Huang fails to teach, disclose, or suggest a solder mask trench that "is situated over a top surface of said laminate circuit board," as specified in independent claims 1, 9, and 16.

Huang also fails to teach, disclose, or suggest a solder mask that "uniformly covers said top surface of said laminate circuit board," as specified in independent claims 1, 9, and 16. As shown in Figure 1 of Huang, the solder mask layer does not uniformly cover

the top surface of chip carrier 1 because only the "trace forming area 101 is applied with a solder mask layer 11 for covering the conductive traces on the trace forming area 101." Huang, column 3, lines 12-15. Huang does not teach, disclose, or suggest that solder mask layer 11 covers chip attach area 100 of chip carrier 1. Thus, Huang clearly discloses that solder mask layer 11 covers only a portion of the top surface of chip carrier 1, i.e., only trace forming area 101.

Huang further fails to teach, disclose, or suggest a solder mask trench situated over a top surface of a laminate circuit board, as specified in amended independent claims 1, 9, and 16. Huang merely discloses that "a recessed portion 13 is formed at the solder mask layer 11 between the pair of the solder pads 12, and preferably dimensioned not to interfere with routing of the conductive traces." Huang, column 3, lines 20-23 (emphasis added). However, the elliptical "recess" shown in Figure 1 of Huang does not suggest the use of a solder mask trench, as specified in independent claims 1, 9, and 16.

Thus, Huang does not teach, disclose, or suggest an overmolded module including a solder mask trench that is situated over a top surface of a laminate circuit board, where a solder mask uniformly covers the top surface of the laminate circuit board, where the solder mask does not cover the solder mask trench, and where the overmolded module is an MCM, as disclosed and claimed in the present application.

In the Final Office Action, the Examiner has acknowledged that Huang "does not expressly disclose wherein the overmolded module is an MCM." The Final Office Action of January 10, 2007, page 3. However, the Examiner has newly cited, and relied for the

first time on, Takiar as overcoming this significant deficiency of Huang. Appellant submits that Takiar also fails to disclose or suggest an overmolded module including a solder mask trench that is situated over a top surface of a laminate circuit board, where the solder mask uniformly covers the top surface of the laminate circuit board, where the solder mask does not cover the solder mask trench, and where the overmolded module is an MCM, as disclosed and claimed in the present application.

Takiar is directed to a stacked MCM including one or more elements, such as a semiconductor die or a substrate material, "stacked" on a semiconductor die, which is attached to a carrier member. *See*, for example, column 4, lines 35-48 and Figure 1 of Takiar. Takiar discloses utilizing proper layout of dice or dice/substrate combinations to achieve wire bonding with no wire cross over and acceptable levels of wire-to-wire separation, where maintaining short wire bond lengths minimizes the potential for wire sweep in the molding of the MCM. Takiar, column 7, lines 16-22 and Figures 1 through 11. However, Takiar fails to teach or disclose an MCM including a surface mount component situated over a laminate circuit board and a solder mask trench situated underneath the surface mount component, where the solder mask uniformly covers a top surface of the laminate circuit board, and where the solder mask does not cover the solder mask trench, as disclosed and claimed in the present application. In fact, Takiar does not even mention a surface mount component or solder mask. Thus, Takiar fails to overcome the deficiencies of Huang discussed above.

Also, as shown in Figures 1 through 11 in Takiar, the electrical connections between semiconductor dies within a stacked MCM and the electrical connections between the semiconductor dies and leads on the stacked MCM are formed by utilizing wire bond technology. By utilizing wire bond technology to provide all of the electrical connections between semiconductor dies and to provide all of electrical connections between the dies and leads on the MCM, Takiar teaches away from utilizing surface mount technology.

In the Final Office Action, the Examiner has stated that "it would have been obvious to one skilled in the art at the time the invention was made to have included an MCM in the manner as taught by Takiar et al in the device as taught by Huang et al as MCMs are commonplace in the art, and are commonly molded in order to provide for good thermal dissipation." The Final Office Action of January 10, 2007, page 3. However, the stacked MCM as taught and disclosed in Takiar is a completely different structure than the chip carrier as taught and disclosed in Huang. Huang teaches and discloses a discrete semiconductor packaging technology, wherein a recessed portion is formed at a solder mask layer to prevent solder paste from shorting between solder pads that are attached to a surface-mounted component on a chip carrier. In contrast, Takiar teaches and discloses a stacked MCM that utilizes wire bonding technology to form connections between stacked dies and between the stacked dies and leads on the MCM.

As such, Appellant submits that, at the time the invention defined by independent claims 1, 9, and 16 was made, the invention would not have been obvious to a person of

ordinary skill in the art since, for example, the invention was not predictable in view of Takiar and Huang, and a person of ordinary skill in the art would not have seen a sufficient benefit in combining Takiar with Huang as suggested by the Examiner. Moreover, no motivation or suggestion to combine Takiar with Huang can be found in either cited reference.

CONCLUSION

For all the foregoing reasons, Appellant respectfully submits that, at the time the invention defined by independent claims 1, 9, and 16 was made, the invention would not have been obvious to a person of ordinary skill in the art by Huang or Takiar, either singly or in combination. Thus independent claims 1, 9, and 16 are patentably distinguishable over Huang and Takiar. Therefore, dependent claims 3-6, 10-14, 18, and 19 are also patentably distinguishable over Huang and Takiar for reasons similar to those discussed above, and further for the additional limitations contained in each dependent claim. Thus, an early allowance of claims 1, 3-6, 9-14, 16, 18, and 19 pending in the present application is respectfully requested.

This Appeal Brief is submitted herewith with an Appendix of the appealed claims and the requisite fee for filing the Appeal Brief.

Respectfully Submitted,
FARJAMI & FARJAMI LLP

Date: 8/7/07

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APPENDIX OF CLAIMS ON APPEAL

Claim 1: An overmolded module comprising:

a surface mount component situated over a laminate circuit board, said surface mount component comprising a first terminal and a second terminal;

a first and a second pad situated on said laminate circuit board, said first pad being connected to said first terminal and said second pad being connected to said second terminal;

a solder mask trench situated underneath said surface mount component, wherein said solder mask trench is situated over a top surface of said laminate circuit board, wherein a solder mask uniformly covers said top surface of said laminate circuit board, and wherein said solder mask does not cover said solder mask trench;

wherein a bottom surface of said surface mount component and said top surface of said laminate circuit board form a moldable gap, said moldable gap including said solder mask trench, wherein said moldable gap and said solder mask trench facilitate a flow of a molding compound underneath said surface mount component, wherein said solder mask trench is filled with said molding compound, and wherein said overmolded module is an MCM.

Claim 3: The overmolded module of claim 1 wherein said moldable gap is filled with said molding compound.

Claim 4: The overmolded module of claim 1 further comprising an overmold, said overmold being situated over said surface mount component.

Claim 5: The overmolded module of claim 1 wherein said surface mount component is selected from the group consisting of a resistor, a capacitor, an inductor, a diplexer, a diode, and a SAW filter.

Claim 6: The overmolded module of claim 3 wherein said moldable gap has a height of between approximately 45.0 micrometers and 65.0 micrometers.

Claim 9: An overmolded module comprising:

a surface mount component situated over a laminate circuit board, said surface mount component comprising a first terminal and a second terminal;

a first and a second pad situated on said laminate circuit board, said first pad being connected to said first terminal and said second pad being connected to said second terminal;

a moldable gap situated underneath said surface mount component, said moldable gap comprising a solder mask trench, wherein said solder mask trench is situated over a top surface of said laminate circuit board, wherein a solder mask uniformly covers said top surface of said laminate circuit board, and wherein said solder mask does not cover said solder mask trench, wherein said moldable gap and said solder mask trench facilitate

a flow of a molding compound underneath said surface mount component, and wherein said solder mask trench is filled with said molding compound, and wherein said overmolded module is an MCM.

Claim 10: The overmolded module of claim 9 wherein said moldable gap is filled with said molding compound.

Claim 11: The overmolded module of claim 9 further comprising an overmold, said overmold being situated over said surface mount component.

Claim 12: The overmolded module of claim 11 wherein said overmold comprises said molding compound.

Claim 13: The overmolded module of claim 9 wherein said moldable gap has a height of between approximately 45.0 micrometers and 65.0 micrometers.

Claim 14: The overmolded module of claim 9 wherein said surface mount component is selected from the group consisting of a resistor, a capacitor, an inductor, a diplexer, a diode, and a SAW filter.

Claim 16: An overmolded module comprising:

a surface mount device situated over a laminate circuit board, said surface mount device comprising a plurality of terminals;

a plurality of pads situated on said laminate circuit board, each of said plurality of pads being connected to a respective one of said plurality of terminals;

a solder mask trench situated underneath said surface mount device, wherein said solder mask trench is situated over a top surface of said laminate circuit board, wherein a solder mask uniformly covers said top surface of said laminate circuit board, and wherein said solder mask does not cover said solder mask trench, and wherein said solder mask trench facilitates a flow of a molding compound underneath said surface mount component, and wherein said solder mask trench is filled with said molding compound, and wherein said overmolded module is an MCM.

Claim 18: The overmolded module of claim 16 wherein said surface mount device is a leadless surface mount device.

Claim 19: The overmolded module of claim 16 wherein said surface mount device comprises at least one component, said at least one component being selected from the group consisting of an active component and a passive component.

EVIDENCE APPENDIX

(NONE)

RELATED PROCEEDINGS APPENDIX

(NONE)